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(54) Cluster mount for high-intensity LED's.

(57) A light-emitting diode cluster mount for concentrating light emitted from light-emitting diodes has a plurality of diode receivers (29) each with a tapered reflector portion (28) concentrating light from the diodes on to a common point (37) on the central axis (35). The reflector portions may be in the form of truncated cones with an included angle between 50° and 75° Each diode receiver may comprise a sleeve arranged to receive a pre-focussed unit (42) comprising a diode mount (44) and a reflector portion (28) provided with interengaging threads for adjustably locating the light-emitting diode relative to its reflector portion.

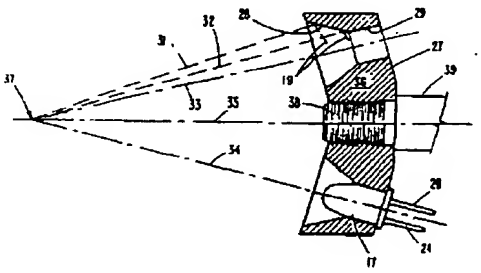

FIG. 4

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BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to light sources of the type employed to illuminate semiconductor integrated circuits during the process of their manufacturing. More particularly, the present invention relates to a cluster mount for concentrating light being emitted from a plurality of high intensity light emitting diodes (LEDs).

2. Description of the Prior Art

Heretofore illuminators for manufacturing of semiconductor equipment have employed fluorescent or incandescent white light which may be supplied directly or though lucite tubes or fiber optic bundles. While such white light sources have been able to be flood or focus white light on the semiconductor chips being processed, the light and/or the light source has consumed excesses or mounts of power and generated unnecessary heat in the workplace.

Experiments using light emitting diodes as light illumination sources have resulted in highly mixed results. Light from light emitting diodes has a narrow wave length varying from various reds in the long wave length spectrum to greens associated with the short wave lengths and narrow spectrum intensity characteristics.

The human eye is more responsive to a broad spectrum of colors which define white light. However, electronic pattern recognition systems have been found to be responsive to narrow spectrum wave lengths of light which fall in the yellow to orange spectrum of colors. The reason for the difference appears to reside in the fact that pattern recognition systems depend upon recognition of different gray scale intensities which can be easily detected within the narrow spectrum light sources such as that produced by LEDs. Presently, there are not commercial available LED light sources which have sufficient candle power to be used with commercially available pattern recognition systems of the type used on semiconductor manufacturing equipment such as wire bonders and mask aligners, etc. Such pattern recognition systems precisely locate a die or a wafer before performing an operational step in the manufacture of the semiconductor part.

Accordingly, it would be desirable to provide a novel illuminator for semiconductor manufacturing equipment which would be particularly suited for use with automatic pattern recognition system equipment.

SUMMARY OF THE INVENTION

It is a principal object of the present invention to provide an apparatus for mounting a plurality of high intensity light emitting diodes (LEDs).

It is another principal object of the present invention to provide a cluster mount for mounting a plurality of LEDs that concentrates and focuses the emitted light at a predetermined point.

It is another object of the present invention to provide a cluster mount for plural LEDs that permits the focusing or pre-focusing of individual LEDs.

It is a general object of the present invention to provide a cluster mount for light emitting diodes which concentrates and focuses most of the emitted light on a predetermined spot to provide optimum gray scale intensity values on the surface of the semiconductor device required by a pattern recognition system.

According to these and other objects of the present invention there is provided an LED cluster mount having a plurality of LED receivers. The cluster mount is provided with a central axis and each of the LED receivers in the cluster mount is displaced from the central axis and has a focus axis which is focused across the central axis at predetermined distance from said cluster mount. Each receiver is provided with an adjustable sleeve portion and a tapered (conical) reflector portion which is adapted to concentrate the light emitted from the LEDs at a predetermined spot.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a radiation diagram for a high intensity light emitting diode showing frontal and side lobes;

Figure 2 is an enlarged high intensity light emitting diode showing a frontal cone and an annular ring of light of the type which is generated by commercially available light emitting diodes;

Figure 3 is an enlarged view of the anode and cathode of a typical stamped lead frame used in the manufacture of light emitting diodes with a LED thereon;

Figure 4 is a cross-section taken through a preferred embodiment cluster mount showing a removable support;

Figure 5 is a front view of a modified cluster mount adapted to hold a plurality of adjustable pre-focused receivers;

Figure 6 is a side view and partial section of the cluster mount shown in Figure 5; and

Figure 7 is an enlarged view in cross-section of one of the adjustable pre-focused receivers of the type used in the cluster mount of Figures 5 and 6.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Refer now to Figure 1 showing a typical radiation diagram for commercially available high intensity light emitting diodes. This diagram shows a central or frontal lobe 11 which is symmetrical to the 0° axis 12. The cylindrical coordinates shown as the percent of light intensity versus angle. Thus, the side lobes 13 and 14 are shown emitting light which is directed approximately 45° in the negative and positive angular coordinate directions. The information in Figure 1 may be interpreted by reference to axis line 15 shown to be approximately -17° from the zero axis and crosses the frontal lobe or beam at the 50% intensity point. Thus, a person looking into the light or lobe along the axis 15 would only encounter 50% of the maximum intensity being emitted along the zero axis as shown in the frontal lobe 11. If the axis is moved in the negative direction closer to the -45° axis 16, the intensity rapidly drops off and then begins to increase as it picks up the side lobe 14. Thus, it will be observed that the intensity of the light is highly dependent on the angle or axis of view looking into the light source.

Refer now to Figure 2 showing an enlarged high intensity light emitting diode 17. The active element of the diode is not shown. The plastic transparent encapsulating cover 21 is in the shape of a parabaloid attached to a base 18 and shown for purposes of explaining the LED light source. It has been found that an annular ring of light 19 is emitted from the transparent cover 21 and is substantially parallel and columnated Further, the frontal cone 22 is found to form a slightly diverging beam of light in the frontal area. This information shown in Figure 2 does not conflict with the commercially available information shown in Figure 1 but is more useful in preparing a reflector for concentrating the light being emitted from the LED.

Refer now to Figure 3 showing an enlarged section of the anode and cathode of a typical stamp lead frame used to support a light emitting diode chip 23. The base of the chip 23 is surface mounted in a bowl shaped receptacle on the first electrode 24 and reflects back light being emitted from the chip 23. The annular ring 19 and the frontal cone 22 are shown in dotted lines for purposes of reference to associated Figure 2. An electrical fine wire 25 is connected to the front face of the chip 23 and electrically connected to the second electrode 26. The electrodes 26 and 24 are shown having leads for connecting the LED 17 to an electrical circuit in both Figures 2 and 3.

Refer now to Figure 4 showing in cross-section a preferred embodiment cluster mount 27 having two or more receivers adapted to the mount and pre-focus the light emitted from the light emitting diodes 17. The cluster mount 27 may be machined from aluminum or made from a plastic material on which highly reflective cones are provided. The reflective cone area comprises a tapered reflector portion 28 and the adjustable sleeve 29 preferably comprises a cylindrical portion. When the cluster mount 27 is originally manufactured, the exact size and dimensions of the LED are known so that the sleeve or receiver portion 29 can be machined to the proper depths so that the aforementioned LED chip 23 is located in the tapered reflector portion at a pre-determined desired position to reflect all of the light being emitted in the form of the aforementioned annular ring 19. Any dispersed light or defused light which is not in the frontal cone 22 will also be refocused along the reflected path shown by dotted lines 31 and 32. Each of the receivers 28, 29 has its own focus axis 33, 34 for each of the LEDs. The focus axis of the LEDs preferably crosses over the central axis 35 of the cluster mount 36. In the preferred embodiment of the present invention the distance from the cluster mount to the area to be illuminated 37 is known and the reflected light from the tapered reflector portion can be focused on this area 37 to provide a complete area or spot of illumination sufficient to completely cover the portion of the chip or wafer being examined by the pattern recognition system. By concentrating several LED sources into a spot or area, the lighted area has been found to be more completely and uniformly illuminated than occurs when using a single point source of light as would occur with a single LED. Further, by employing a plurality of LEDs it is possible to design the light so that it provides the proper intensity and the required uniformity for optimum use of pattern recognition systems employing TV cameras. The mount 36 is provided with a threaded hole 38 which receives a support shaft 39 used to support the cluster mount 36.

Refer now to Figures 5 to 7 showing a modified cluster mount 41 shown in front and side views in Figures 5 and 6. The modified cluster mount 41 is designed to receive a plurality of adjustable pre-focus receivers 42 of the type shown in Figure 7. When commercially available LEDs 17 are supplied by different manufacturers, the aforementioned annular ring of light 19 may be occurring at a point measured from the base 18 which differs. By employing the receiver 42, it is possible to mount the base 18 in the male threaded portion 44 and adjust it in the female portion 43. By adjusting the male portion 44 it is possible to position the annular ring 19 at the optimum position of the highly reflective cone 28. Thus, different types and/or colors of commercially available LEDs 17 may be pre-fo-

cused in the adjustable receivers 42 and then placed in the modified cluster mount 41 without the requirement for refocusing. It will be understood that the light being emitted from the adjustable receiver 42 basically is a columnated light source composed of two light cones: 1) a diverging frontal cone 22 and 2) a converging cone of annular ring light 19. The modified cluster mount 41 is provided with a female threaded portion 45 in the rear which is used to attach the cluster mount to a support at a desired distance from the area to be illuminated.

Having explained a cluster mount which may be machined from a metal which may be polished to a high reflective surface, it will be understood that the same mount may be made from other metals or plastic and a highly reflective tapered reflector portion added. Such tapered reflector portions may be made in the form of a truncated cone or parabaloidical or empirically designed to obtain the properly desired focus of the reflected beam.

It will be further understood that the adjustable pre-focus receivers 42 of the type shown in Figure 7 may be further modified by eliminating the male portion 44 of the receiver and supplying spacing rings and mounting rings against shoulder 46 in portion 43 for the LED 17 so as to obtain the proper position of the LED chip relative to the highly reflective tapered portion 28.

It has been found that light emitting diodes having wave lengths which fall in the color spectrum between yellow and light red provide the proper color and intensity for optimum gray scale intensity illumination of semiconductor die and wafers for use with pattern recognition systems. However, since the preferred embodiment cluster mounts may employ more than two and up to six individual LEDs it is possible to mix the color spectrum of the LEDs to achieve a broader range of wave lengths for some specific applications.

Claims

1. A light-emitting diode cluster mount for concentrating light emitted from a plurality of light-emitting diode chips (23) encapsulated in transparent carriers (17), characterised in that it comprises a mount (36) having a central axis (35) and a plurality of diode receivers (29) each provided with an adjustable sleeve portion (29) for positioning a light-emitting diode and each with a tapered reflector portion (28) the diodes and reflector portions being so arranged that light from the light emitting diodes is focussed to a common point (37) on the central axis (35) of the cluster mount.

2. A light-emitting diode cluster mount according to claim 1 in which each tapered reflector portion (28) comprises a truncated cone.

3. A light-emitting diode cluster mount according to claim 2 in which each truncated cone has an included angle between 50° and 75°

4. A light-emitting diode cluster mount according to claim 2 or claim 3 including light-emitting diodes of the type emitting an annular ring (19) of side light, and in which each truncated cone is deeper than the annular ring of side light.

5. A light-emitting diode cluster mount according to any preceding claim in which each diode receiver (29) comprises a sleeve arranged to receive a pre-focussed unit (42) comprising a diode mount (44) and a tapered reflector portion (28)

6. A light-emitting diode cluster mount according to claim 5 in which each diode mount (44) and its corresponding tapered reflector portion (28) are provided with interengaging threads for adjustably locating the light-emitting diode relative to its reflector portion.

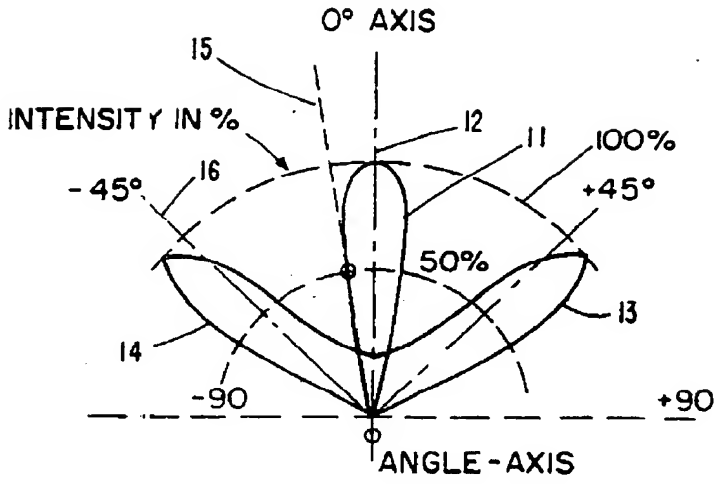

FIG. 1

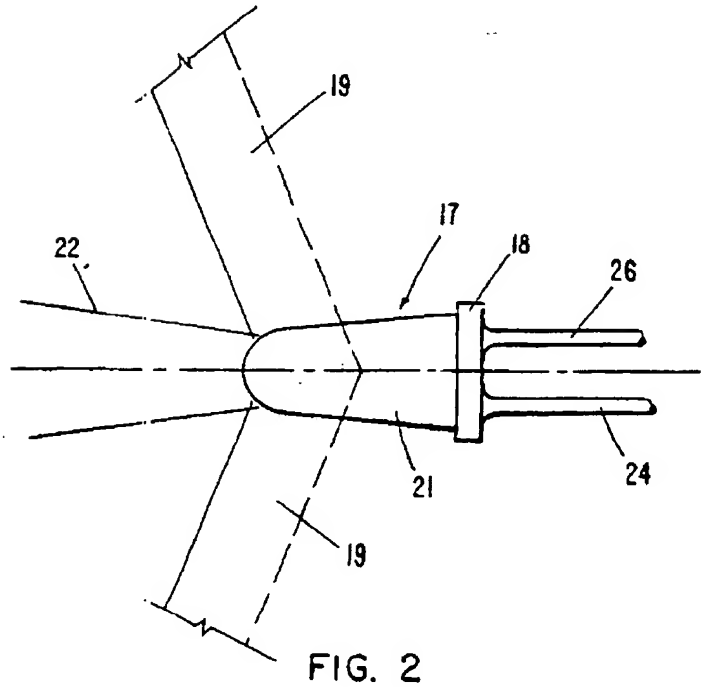

FIG. 2

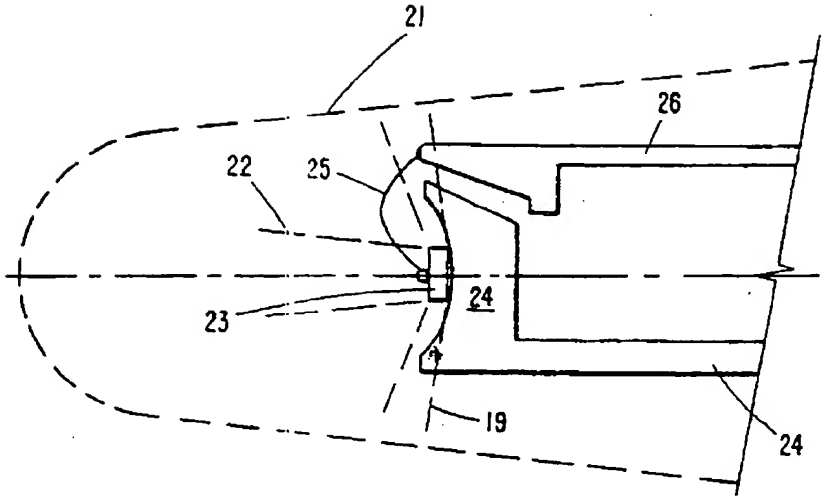

FIG. 3

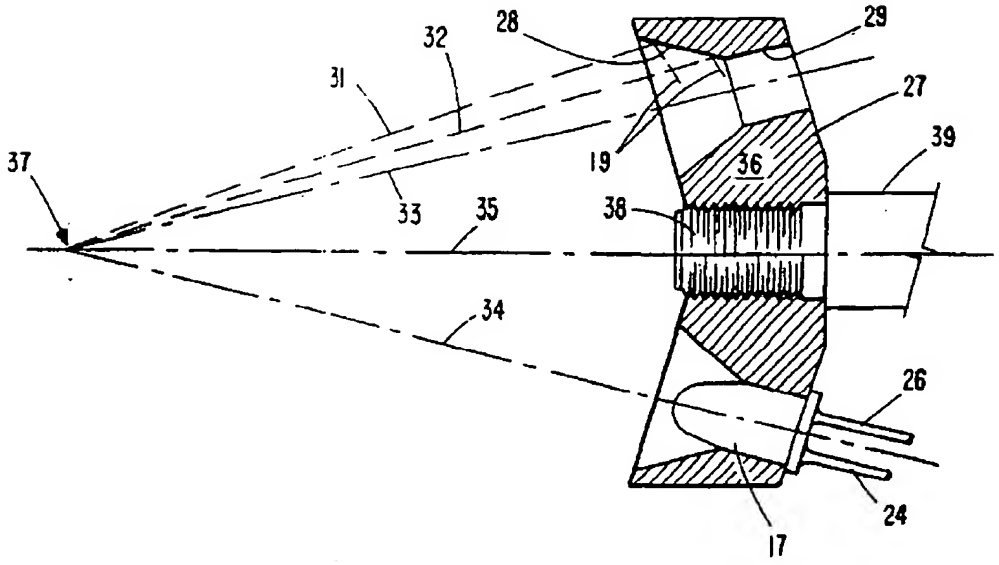

FIG. 4

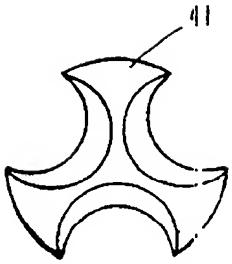

FIG. 5

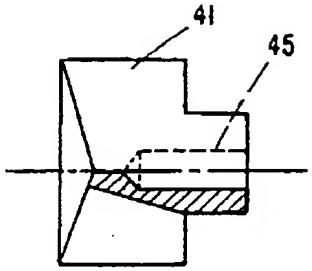

FIG. 6

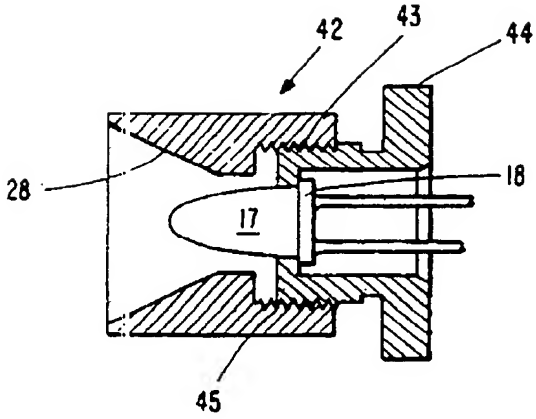

FIG. 7

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EUROPEAN SEARCH REPORT

Application Number

EP 91 30 2139

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	US-A-4 869 580 (QUALITY TECHNOLOGIES CORPORATION) * column 2, line 63 - column 3, line 11; figure 2 *	1-6	H 01 L 33/00 H 01 L 25/075
A	PATENT ABSTRACTS OF JAPAN vol. 8, no. 173 (E-259)(1610) 09 August 1984, & JP-A-59 67672 (FUJI XEROX KK) 17 April 1984, * the whole document *	1-6	
A	EP-A-0 184 877 (RTC LA RADIOTECHNIQUE COMPELEC) * page 6, line 19 - page 8, line 24; figure 4 *	1-6	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

H 01 L

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	19 August 91	LINA F.

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
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